Limited Visual Dam Safety Inspection Summary Report

MA-089

Reservoir 90

Maui, Hawaii

Prepared by:

U.S. ARMY CORPS OF ENGINEERS
HONOLULU ENGINEER DISTRICT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

May 2006

Dam ID: MA-0089
Name: Reservoir 90

Limited Visual Dam Safety Inspection Conducted on: 04 April 2006

I. Purpose

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections are authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statues, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections are being conducted under joint agreements of the U.S. Army Corps of Engineers (USACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection will be made on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works would include the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may appear to be no immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

V. Inspection Team

Organization	Name /Title
U.S. Army Corps of Engineers	Henri Mulder, P.E. Civil Engineer
State of Hawaii, Dept. of Land and Natural Resources	Hiram Young

VI. Owner's Representatives Present

Hawaiian Commercial and Sugar Company	Randall Moore Lloyd Taguchi

VII. Summary Report Team

Organization	Name
U.S. Army Corps of Engineers	Derek Chow Bill Empson
State of Hawaii, Dept. of Land and Natural Resources	Denise Manuel Edwin Matsuda

VIII. Dam Type

The dam appeared to be an earthen embankment dam.

IX. Dam Classification

The current hazard classification of this dam is: Significant

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Most likely Small but insufficient information is available to inspectors to make a determination.

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

X. Summary of Inspection

Condition Rating Criteria: The conditional terms in this report are used to generally describe the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

Dam ID: MA-0089
Name: Reservoir 90

A. General appearance:

The dam consists of an earth fill embankment. The dam is approximately 19 feet tall and 1250 feet long. The dam is feed an irrigation ditch. The purpose of the reservoir is irrigation.

Findings and Corrective Actions:

a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
b. An Emergency Action Plan (EAP) is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
c. Routine inspection logs were not inspected.
d. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
e. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
f. Power / Communication: There were no communication systems observed on this reservoir.

B. Access / Security:

Access to the dam was accomplished via a private roadway.
A four-wheel drive vehicle is required.

Security issues. Access to the dam is unrestricted.

C. Intake Works:

The reservoir has 1 intake.
The intake ditch is trapezoidal shaped with a 3-foot base on a 1 on 1-side slopes.
The ditch is concrete lined.
The control of the ditch is by a gate, and the flow can either be shut off or bypassed.
The source is from the irrigation ditch.

Findings and Corrective Actions:

a. The intake works were not tested.
b. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time

D. Reservoir:

The reservoir level was 13.5 feet per dam operator.
The reservoir level varies from 12 to 13 feet per dam.
The normal operating level is kept within normal range.
No staff gage was found at the time of inspection.

Findings and Corrective Actions:

a. The reservoir was not inspected.
b. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.

E. Upstream Slope: (Fair)

The upstream slope was 1 on 1 slope to 1 on 1.5 slope.
The upstream slope is protected by dumped rock. There is no riprap to the left of spillway and benching of the slope has occurred.
There is loose soil with little vegetation. There is a 3-foot high benching to the left of the spillway.
Cracks and sinkholes were not visible at the time of inspection.
The dense vegetation made inspection difficult with bushes, tall grass and lots of trees.

Findings and Corrective Actions:

a. The upstream slope appeared to be in fair to poor condition and requires corrective action.
b. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair.
c. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
d. Tree(s) were observed on the dam embankment. Trees have been identified as the probable cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2” diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of a licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage

F. Crest: (Fair)

The dam crest was approximately 20 to 40 feet wide.
Access to the crest is by a 20-foot wide dirt road on 1/3 of the crest. Remaining 2/3 of the crest is overgrown with vegetation.
Over 2/3 of the crest had dense vegetation that made inspection difficult. Need to remove vegetation from crest and maintain grasses short.

Findings and Corrective Actions:

a. The dam crest appeared to be in fair to poor condition and requires corrective action.
b. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
c. Tree(s) were observed on the downstream slope. Trees have been identified as the probable cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of a licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

G. Downstream Slope: (Fair)

The downstream slope was approximately 1 on 1 slope to 1 on 1.5 slope.
Access was lower roadway along toe to outlet works.
There was no slope protection observed at the time of inspection.
Erosion, cracks and sinkholes were not visible, because of the dense vegetation at the time of inspection.
Visual inspection was difficult due to the dense vegetation.
There was no seepage observed at the time of inspection.

Findings and Corrective Actions:

a. The downstream slope appeared to be in fair to poor condition and requires corrective action.
b. The downstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
c. Tree(s) were observed on the downstream slope. Trees have been identified as the probable cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of a licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
d. The slope was very steep, around a 1 to 1 slope; further study is required to verify slope stability.

H. Abutments / Toe: (Satisfactory)
There was a 40-foot wide road along the downstream toe. Good access along toe.

Findings and Corrective Actions:
a. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.

I. Outlet Works: (Satisfactory)
There are two 30" diameter steel pipes.
The control of the outlet is with a valve that is on the downstream side.

Findings and Corrective Actions:
a. The outlet works were not tested.
b. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

J. Spillway: (Fair)
This spillway is consisted of a channel on the right abutment.
The dimension is 18 feet. The invert elevation is 134 feet NGVD.
The slope protection consists of concrete.
Erosion was not observed at the time of inspection.
There was minor amount of vegetation on the right side of the spillway at the sill.

Findings and Corrective Actions:
a. The Spillway appeared to be in fair to poor condition and requires corrective action.
b. Remove vegetation on right side of the spillway approach channel.

K. Down Stream Channel: (Unknown)

Findings and Corrective Actions:
a. The downstream channel was not inspected.

XI. Additional Comments:

There is no immediate threat to the safety of the dam.

Recommendation:
1) Place erosion protection (i.e. riprap) on the upstream slope to the left of the spillway where benching is observed.
2) Remove underbrush and trees from the embankment. Grasses should be kept short.

PHOTOGRAPHS

MA-089 Maui Reservoir 90

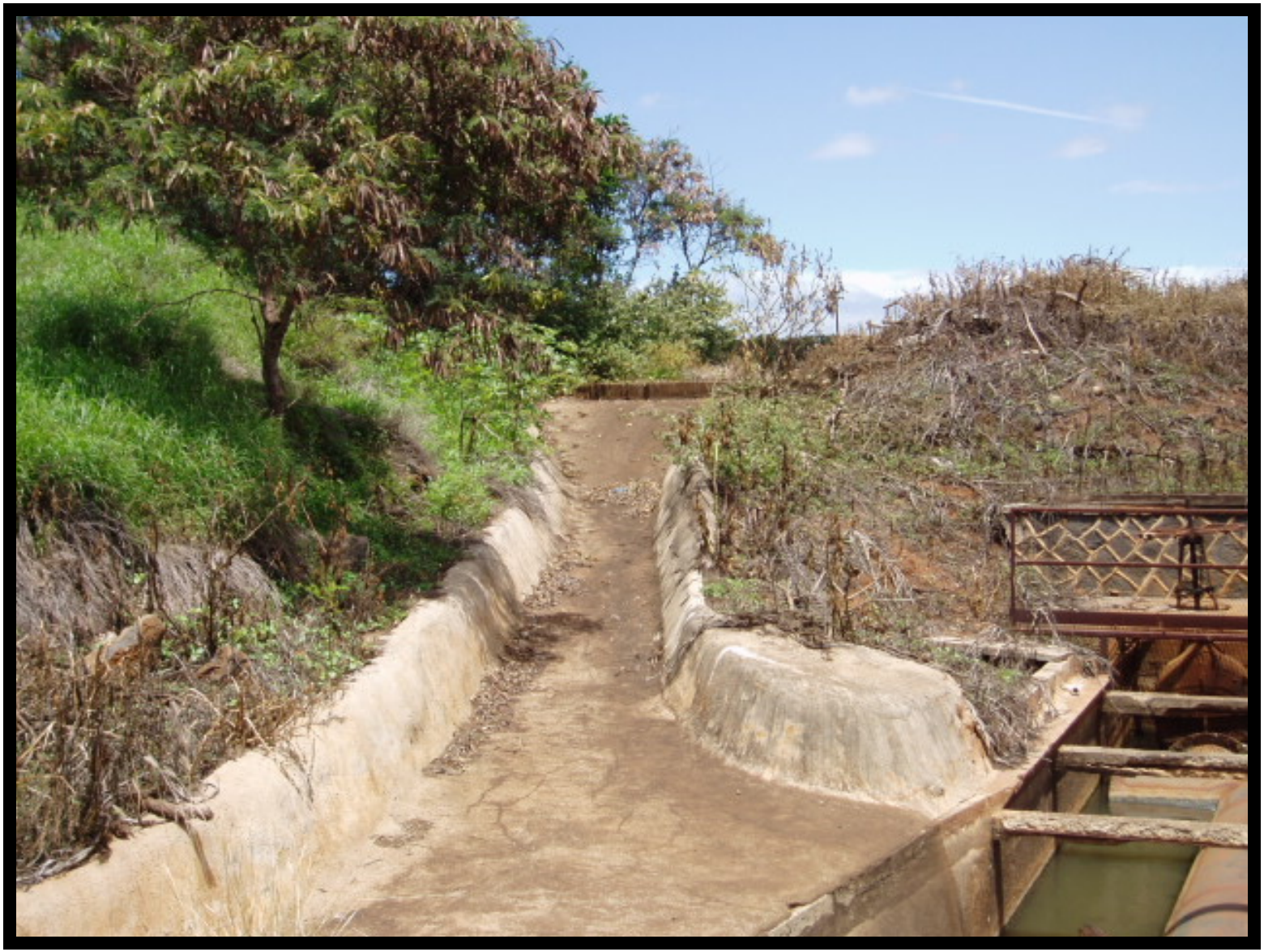
MA-089 Maui Reservoir 90

089 Crest overgrown with vegetation.

MA-089 Maui Reservoir 90

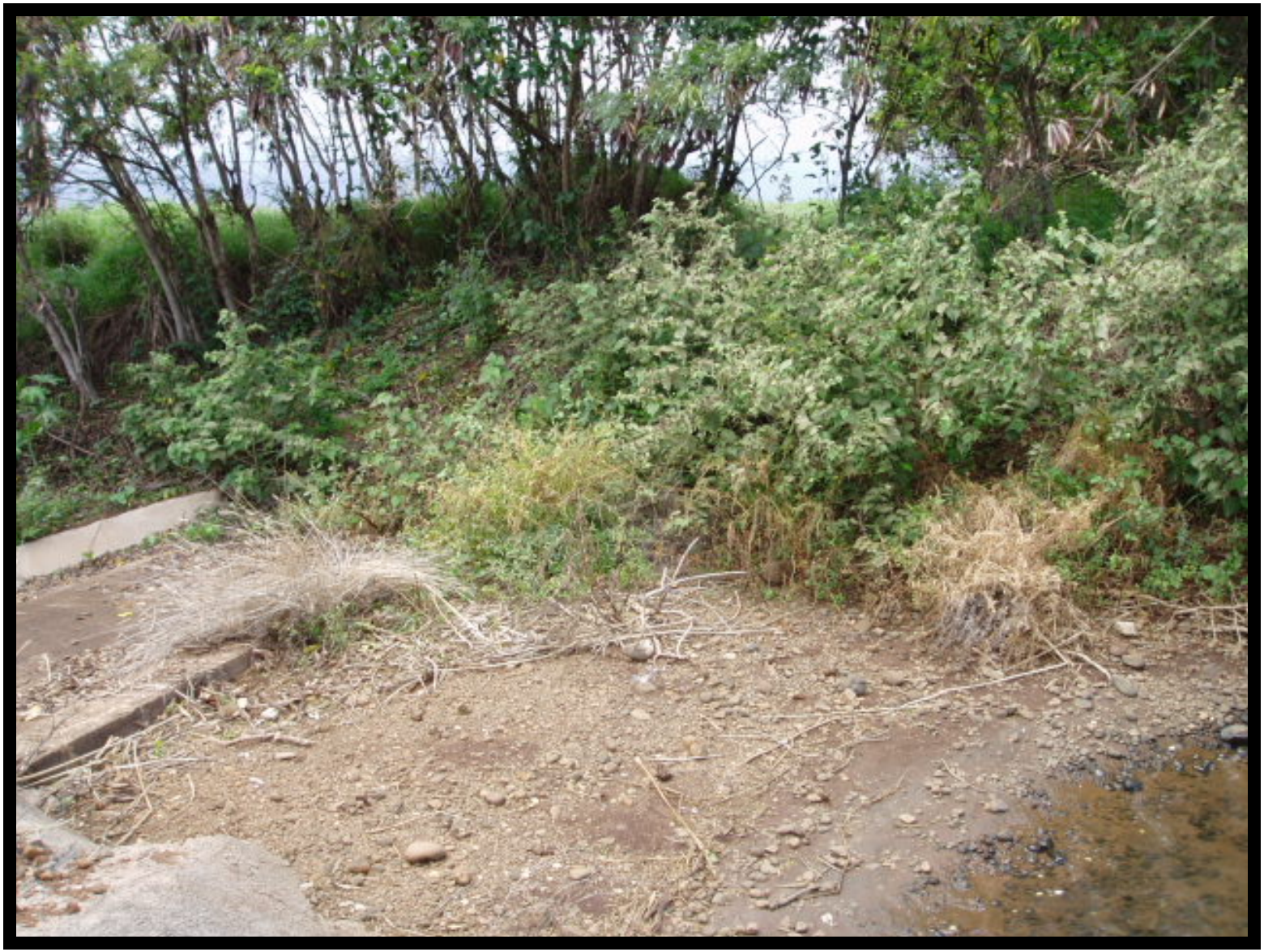
089 Downstream slope of the dam. Note the dense vegetation on the slope.

MA-089 Maui Reservoir 90



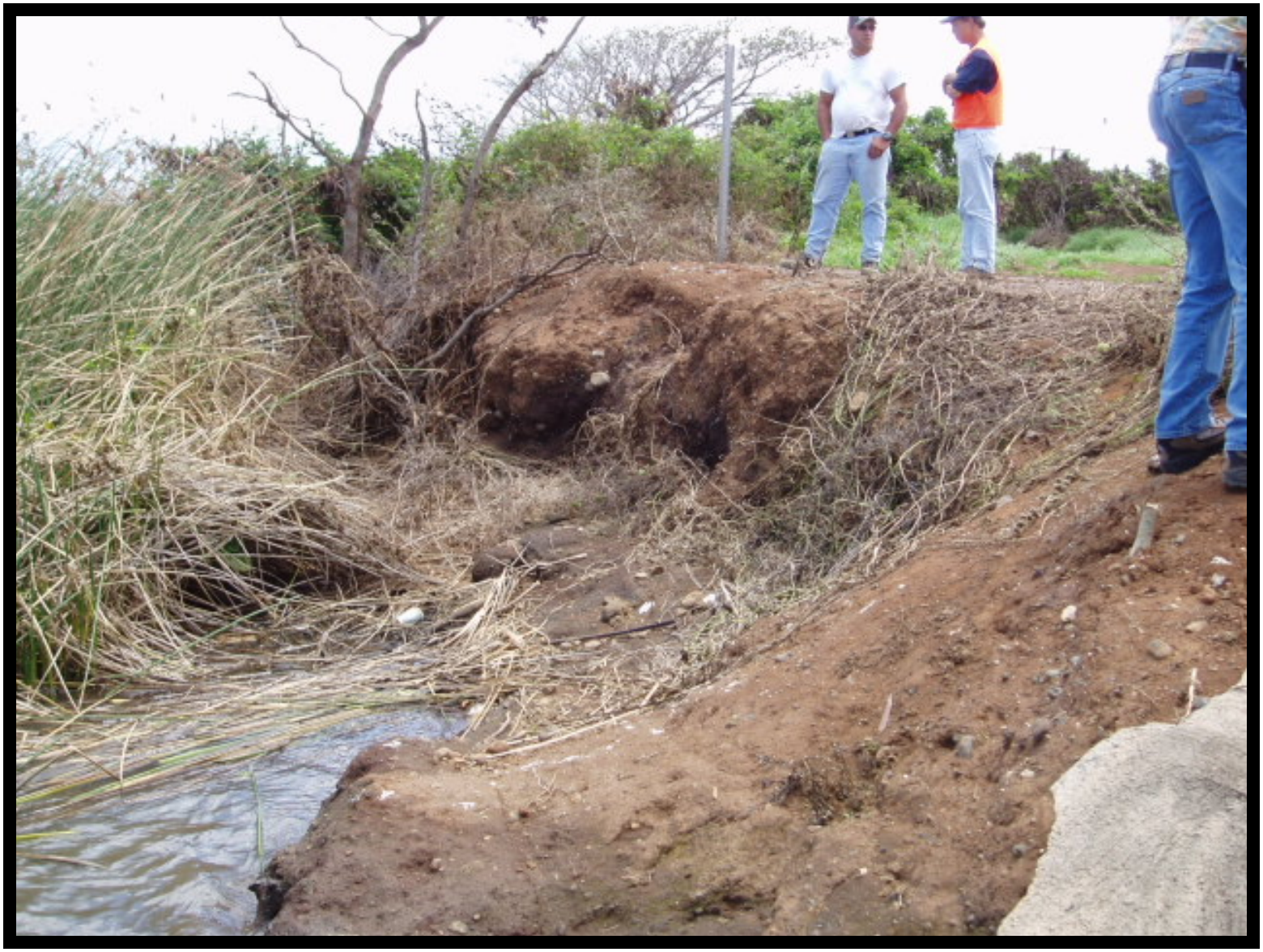
089 spillway

MA-089 Maui Reservoir 90



089 Vegetation at the spillway approach channel.

MA-089 Maui Reservoir 90



089 Benching on the upstream slope to the left of the spillway.

FIELD INSPECTION SHEETS

Dam ID: MA-0089
RESERVOIR 90

(4)

Vulnerability Index:
Extreme 1 High 2 Moderate 3 Low 4

Inspection No:
Date: 4/4/2006

STATE OF HAWAII - DLNR
DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

Persons Present	Affiliation	Phone Number
HENRI MULDER	US Army Corps of Engineers	
HIRAM YOUNG	DLNR	
RANDALL MOORE	HC&S	
LLOYD TAGUCHI	HC&S	

Weather Condition: ☐ Rain previous day ☐ Rainy ☐ Drizzle / Mist ☐ Cloudy/Overcast ☒ Partly Cloudy ☐ Sunny ☒ Dry

Comments:

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1. General: *(Information currently on file, update as required)*

Dam/Res. Name: RESERVOIR 90
Owner: Hawaiian Commercial & Sugar Company, a division of Alexander & Baldwin, Inc. *(C010)*
Owner Contact: Mr. Randall Moore — Owner Ph.:
Lessee: N/A — Lessee Ph.:
O & M Contractor: HC&S — O & M Ph.:
Nearest Town: — Latitude: 20.825° (decimal)
County: MAUI — Longitude: 156.4567° (decimal)
Tax Map Key(s): (2)3-8-008:005

Dam Status	A:	Hazard Potential	S:	Dam Size	
Year Completed	1917	Dam Length	1250 ft.	Dam Height	19 ft.
Normal Storage	132 ac.ft.	Max. Storage	142 ac.ft.	Max. Surface Area	ac.
Drainage Area	mi.	Spillway Type		Max. Spillway Q	cfs

Owner owns land under dam facility:
Emergency Action Plan on file with the Department: NO
Reports on file with the Department: None on file.

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2. Questions for Owner's Rep.:

	Yes	No	Unknown	Comments
Construction Plans Available	☐	☒	☐	
Site / Facility Map	☒	☐	☐	
Operation & Maintenance Manual	☐	☒	☐	
Emergency Action Plan	☐	☒	☐	
Modifications / Improvements	☐	☒	☐	
Conduct Routine Inspections	☒	☐	☐	
Conduct Routine Maintenance	☒	☐	☐	
Vehicle access to site	☒	☐	☐	☐ Not accessible ☐ With Standard car ☒ Requires 4-Wheel Drive
Access during heavy rains	☒	☐	☐	☐ Not accessible ☐ With Standard car ☒ Requires 4-Wheel Drive
Access when spillway is flowing	☒	☐	☐	☐ Not accessible ☐ With Standard car ☒ Requires 4-Wheel Drive
Other Studies Conducted	☐	☒	☐	☐ Phase I ☐ Phase II ☐ Hydraulics ☐ Stability ☐ Hazard ☐ Seismic ☐ Other: _____
Incident History	☐	☒	☐	☐ Breached ☐ Overtop ☐ Slide ☐ Down stream Flooding ☐ Other: _____
Reservoir's Current Use	☒	☐	☐	☐ Sediment ☒ Irrigation ☐ Recreation ☐ Flood Control ☐ Drinking Water ☐ Power Generation ☐ Other: _____

Findings and Corrective Actions:

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☐ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- ☒ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☒ f. Routine inspection logs were not inspected.
- ☐ g. Dam owners shall provide for routine inspection of the dam.
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☐ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☒ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☐ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☐ o. _____

Additional Requirements:

The following investigative study(s) are:

Required	Recommended	
☐	☐	Phase I Study
☐	☐	Phase II Study (Including ☐ Seepage ☐ Hydrology/Hydraulics ☐ EAP)
☐	☐	Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity)
☐	☐	Stability Analysis
☐	☐	Seismic Analysis
☐	☐	Hazard Classification
☐	☐	Other: _____

Dam ID: MA-0089
RESERVOIR 90

Inspection No: _____
Date: 4/4/2006

Physical Dam Features: (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

3. Reservoir:

Level during inspection 13.5' ft per dam operator (gage / other)

Normal Operating Level/Range 12-13 ft per dam (gage / other)

Description: _____

Typical Operation ☐ Spillway always flowing ☒ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms

☐ Other: _____

Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☒ Not Visible ☐ None Observed

Description: _____

Staff Gage: Description: No staff gage

Findings:

☒ a. The reservoir was not inspected.
☐ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

☐ e. The staff gage needs maintenance and/or repair. Description: _____
☒ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
☐ h. _____

4. Intake Works Description:

☒ Number of Intakes 1

☐ Intake Culvert / Pipe

Size: _____ in. ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

☒ Ditch / Flume

Dimension: 3' base; 1:1 s/sides (Size x Depth) Shape Trapezoid channel

Surface: ☐ Dirt ☐ Wood ☒ Concrete ☐ Lined w/ _____

Control: ☒ Gate ☐ Valve ☒ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☒ Other Irrigation ditch

Findings:

☐ a. The intake works were not inspected.
☒ b. The intake works were not tested.
☒ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

☐ f. The intake works needs maintenance and/or repair. Description: _____
☐ g. _____

Dam ID: MA-0089 RESERVOIR 90	Inspection No: _____ Date: 4/4/2006

5. Upstream Slope: (Typical Slope ± 1 : 1 to 1.5)

Slope Protection: ☐ None ☒ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner _____ ☐ Other: _____

☐ Defect in Protection: Description: No riprap to the left of spillway. Benching of the slope is occurring

Erosion: ☒ Loose soil w/ little vegetation ☐ Rut (<6") ☒ Gully (>6" deep) ☐ Not Visible ☐ None Observed

Description: 3' high benching to the left of spillway

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed

Description: _____

Sinkholes: ☐ # Observed: _____ Size: _____ and _____ Depth ☒ Not Visible ☐ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # lots ☒ <6" ☒ >6" & <20" ☐ >20"

Description: Dense vegetation made inspection difficult

Findings:

☐ a. The upstream slope was not inspected.

☐ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.

☒ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.

☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. Slope protection needs maintenance or repair. Description: _____

☒ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: SEE ABOVE

☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.

☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.

☒ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

☒ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

☐ k. _____

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6. Crest: Approximate Crest Width: 20' to 40'

Access: ☒ None ☐ Walking Path ☒ Roadway, Surface / Width / Usage: 20' wide dirt road on 1/3 of crest. Rest of crest is overgrown with vegetation

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed
Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☒ Not Visible ☐ None Observed
Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # lots ☒ <6" ☐ >6" & <20" ☐ >20"
Description: Over 2/3 of the crest had dense vegetation that made inspection difficult. Need to remove vegetation from crest

Findings:

- ☐ a. The dam crest was not inspected.
- ☐ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Access along the crest was satisfactory.
- ☐ f. Access along the crest was not possible. Description: _____
- ☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: _____
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☒ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☒ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ l. _____

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7. Downstream Slope: (Typical Slope ± 1 : 1 to 1.5)

Access: ☒ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☐ None Observed

Slope Protection: ☒ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☒ Not Visible ☐ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # lots ☒ <6" ☐ >6" & <20" ☐ >20"

Description: Dense vegetation makes inspection difficult

Seepage:

Seep Spot Number 1

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Seep Spot Number 2

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

☐ a. The downstream slope was not inspected.

☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.

☒ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.

☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. Slope protection needs maintenance or repair. Description: _____

☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____

☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.

☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.

☒ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

☒ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.

☒ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.

☐ k. _____

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8. Abutments/Toe:

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed
Description: _____

Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: 40' wide road along D/S toe; Good access along toe

Seepage:
Seep Spot Number 1
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Findings:

☐ a. The abutments/toe were not inspected.
☒ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. Slope protection needs maintenance or repair. Description: _____
☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair. Description: _____
☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☐ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☐ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
☐ l. _____

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Invert elevation of outlet works is 123'

9. Outlet Works:

Culvert / Pipe

Type / Size: Two 30" ϕ

Culvert: ☐ Concrete ☐ Masonry ☐ unlined earth ☐ Other _____

Pipe: ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☒ Other steel

Control Type: ☐ Gate ☒ Valve ☐ Other _____

Location: ☐ Control on Upstream side ☒ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

☐ a. The outlet works were not inspected.

☒ b. The outlet works were not tested.

☒ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

☐ d. The outlet works appeared to be in fair to poor condition and requires corrective action.

☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.

☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

☐ i. _____

☐ j. _____

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10. Spillway:

Type: ☐ None ☐ Culvert/Pipe ☒ Channel
Description: _____

Dimension: 18 ft. Invert elevation: 134 ft. per staff gage

Slope Protection: ☐ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☒ Concrete
☐ Defect in Protection: Description: _____

Approach: ☐ Clear ☒ High Veg. ☐ Trees ☐ Other: Minor amount of vegetation on right side

Erosion: ☐ Scour ☐ Gully ☐ Headcut ☒ Not Observed ☐ Other: _____
Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: Minor amount of vegetation on right side of spillway at sill.

Findings:

☐ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.
☒ b. The Spillway appeared to be in fair to poor condition and requires corrective action.
☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ d. Slope protection needs maintenance or repair. Description: _____
☐ e. The spillway approach was blocked. Clear approach.
☐ f. Severe scour erosion was observed which requires maintenance and/or repair.
Description: _____
☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.
☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
☒ j. Remove vegetation on right side of spillway approach channel.

11. Down Stream Channel:

Name: _____
Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☐ Defined Drainage-way ☐ Other _____
Items along Stream Bank: ☐ None ☐ Road ☐ Houses ☐ Town ☐ Not Inspected
Description: _____

Findings:

☒ a. The downstream channel was not inspected.
☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.
☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. _____

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Additional Comments:

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

FINDINGS

Conclusions: There is no immediate threat to the safety of the dam.

Place erosion protection (i.e., rip-rap) on the upstream slope to the left of the spillway where benching is observed.

Underbrush and trees should be removed from the embankment. Grasses should be kept short.

Limitations and Intent of this Dam Safety Inspection:

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statures Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

Revised: Dec. 1, 2003